ORIGINAL RESEARCH

Is Discordance Between Recommended and Actual Postacute Discharge Setting a Risk Factor for Readmission in Patients With Congestive Heart Failure?

Aileen Chou iD, PT, DPT; Tracey Euloth, MPT; Beth Matcho, PT; Amy M. Pastva iD, PT, MA, PhD; Andrew Bilderback, MS; Janet K. Freburger iD, PT, PhD

BACKGROUND: Readmissions in patients with congestive heart failure are common and often preventable. Limited data suggest that patients discharged to a less intensive postacute care setting than recommended are likely to readmit. We examined whether postacute setting discordance (discharge to a less intensive postacute setting than recommended by a physical and occupational therapist) was associated with hospital readmission in patients with congestive heart failure. We also assessed sociodemographic and clinical predictors of setting discordance.

METHODS AND RESULTS: Retrospective analysis of administrative claims and electronic health record data was conducted on 25 500 adults with a discharge diagnosis of congestive heart failure from 12 acute care hospitals in Western Pennsylvania. Generalized linear mixed models were estimated to examine the association between postacute setting discordance and 30-day hospital readmission and to identify predictors of setting discordance. The 30-day readmission and postacute setting discordance rates were high (23.7%, 20.6%). While controlling for demographic and clinical covariates, patients in discordant postacute settings were more likely to be readmitted within 30 days (adjusted odds ratio [OR], 1.12; 95% CI, 1.04–1.20). The effect was also seen in the subgroup of patients with low mobility scores (adjusted OR, 1.20; 95% CI, 1.08–1.33). Factors associated with setting discordance were lower-income, higher comorbidity burden, therapist recommendation disagreement, and midrange mobility limitations.

CONCLUSIONS: Postacute setting discordance was associated with an increased readmission risk in patients hospitalized with congestive heart failure. Maximizing concordance between therapist recommended and actual postacute discharge setting may decrease readmissions. Understanding factors associated with post-acute setting discordance can inform strategies to improve the quality of the discharge process.

Key Words: heart failure ■ occupational therapy ■ physical therapy ■ postdischarge rehabilitation ■ readmission

A staggering public health problem, congestive heart failure (CHF) affects over 6 million Americans and is associated with substantial mortality, morbidity, and healthcare expenditures, costing over $39 billion a year.[1] CHF is the leading cause of hospitalizations in older people (≥65 years), accounting for over 1 million hospitalizations annually.[2]

Unplanned readmissions are astoundingly common, with nearly 1 in 4 patients with CHF being readmitted within 30 days of hospital discharge.[3] Many of these readmissions are considered preventable.[4] In 2013, the Centers for Medicare and Medicaid Services' Hospital Readmissions Reduction Program[5] initiated financial penalties for hospitals with high 30-day

CLINICAL PERSPECTIVE

What Is New?

- A total of 25 500 patients with primary or secondary discharge diagnoses of congestive heart failure and evaluations from rehabilitation therapists had 30-day all-cause readmission rates of 23.7%, and 1 in 5 patients received less intensive postacute care rehabilitation than recommended by the therapists.
- Patients who discharged to a discordant postacute rehabilitation setting were associated with a higher risk of readmission, and a subgroup with lower physical function scores had an even greater risk.
- There was less adherence to therapists' discharge setting recommendation if patients had a lower income, more comorbidities, midrange mobility limitations, and conflicting recommendations from both therapists.

What Are the Clinical Implications?

- Thirty-day readmission rates are high for patients with congestive heart failure, as are nonadherence rates to therapists' postacute rehabilitation recommendations.
- The quality of the discharge process may improve when incorporating clear and consistent therapist postacute setting discharge recommendations with multidisciplinary discharge planning.
- Mediating risk factors for discordant discharges is a potential strategy to increase healthcare value and patient outcomes.

Nonstandard Abbreviations and Acronyms

ADL	activities of daily living
AM-PAC	Activity Measure for Post-Acute Care
IRF	inpatient rehabilitation facility
OT	occupational therapist
PT	physical therapist
SNF	skilled nursing facility

risk-standardized readmission rates for patients hospitalized for acute CHF.

One key factor that may decrease the risk of hospital readmission and improve patient outcomes is successful coordination of discharge recommendations made by the patient's care team.[6] For example, helping the patient and family make informed and suitable decisions about postacute care may prevent readmission.[6] Physical therapists (PTs) and occupational therapists (OTs) play key roles in determining the most appropriate postacute care setting for patients discharged from the acute care hospital with physical and cognitive impairments. Therapists use a complex decision-making process for discharge planning based on the patient's impairments and fall risk, the patient's capacity to perform basic activities of daily living (ADL) within their individual environment (eg, bed mobility, walking, transfers), the ability of the caregiver to provide physical and social support as needed, and patient and family preference.[7,8]

There are varying levels of postacute rehabilitation care. Inpatient rehabilitation facilities (IRFs) abide by Centers for Medicare and Medicaid Services guidelines providing at least 3 hours of rehabilitation a day for 5 days a week.[9] Patients discharged to an IRF must be able to tolerate the intensity of the rehabilitation. Skilled nursing facilities (SNFs) do not have specific rehabilitation intensity guidelines but are considered a "less intensive" setting relative to IRFs; patients in SNFs may be seen 5 days a week for rehabilitation but for less time. The frequency and duration of community-based home health rehabilitation varies but on average is about 2 to 3 times per week, with patients often given an exercise program to follow on the days not seen by a therapist. Because exercise intensity in the CHF population yields better outcomes, getting patients to the appropriate rehabilitation discharge setting where exercise is adequately dosed is important.[10,11]

Limited evidence on small, heterogeneous samples suggests that readmission risk increases when postacute rehabilitation recommendations by therapists are not followed.[12,13] Our study extends prior work on the association between setting discordance (ie, disagreement between the recommended versus actual discharge setting) and risk of hospital readmission by focusing on CHF, a high-priority discharge diagnosis; examining a larger sample of patients across multiple geographically diverse hospitals; using recommendations from both PTs and OTs; and including important covariates in our analyses representing the patients' clinical and functional status. The objectives of our study were to (1) describe the degree of postacute care setting discordance (defined as the patient being discharged to a less intensive postacute setting than recommended by the PT and OT) for patients discharged from the acute care setting with a diagnosis of CHF; (2) examine the association between setting discordance and 30-day all-cause hospital readmission; and (3) identify sociodemographic and clinical predictors of setting discordance. We hypothesized that patients discharged to a lower-intensity setting than recommended by the therapist would have increased odds of hospital readmission when compared with those who were discharged to the same

or higher-intensity setting than recommended. We also hypothesized that both sociodemographic and clinical characteristics would be associated with postacute setting discordance.

METHODS

Study Design and Sample

This retrospective cohort study examined electronic health records and administrative claims data from a large healthcare system in Western Pennsylvania. Data from January 1, 2016, to March 30, 2018, were examined. The data used in this study are proprietary, and per UPMC policy, data disclosure would require a suitable data use agreement requested to UPMC Quality Review Committee at AskQRC@upmc.edu. Details on the creation of our analytic data set and the statistical programming are available by the corresponding author upon request.

We identified patients admitted to 1 of 12 acute care hospitals located in urban and rural settings with a primary or secondary CHF diagnosis based on *International Classification of Diseases, Tenth Revision* (*ICD-10*) codes (Table S1). Patients were included if they were aged ≥18 years, survived their acute care stay, and received at least one PT or OT visit during their stay. Patients were excluded if they transferred to another hospital, died within 30 days after discharge, had missing discharge destinations, or had missing or unclear postacute care recommendations by the therapist.

Study Variables

Our outcome variable was 30-day all-cause, within health system readmission. Our exposure variable was postacute care setting discordance, defined as being discharged to a less intensive rehabilitation setting than recommended by the therapist.[6,13] The patients' discharge destinations were extracted from billing data and categorized as: home, home with home health therapy, or postacute care facility (SNF or IRF). Discharge to a SNF or IRF may depend upon availability[14] and patient insurance[15]; therefore, we combined these 2 categories to represent facility-based

postacute care.[16–19] PT and OT postacute care recommendations were extracted from the electronic health record discharge planning section and included the following options: home without therapy, home with outpatient therapy, home with home health, or postacute facility (ie, SNF or IRF). In instances when the PT and OT recommendations did not agree (15.5%), we assigned the PT recommendation because PTs, on average, had more visits with the patients relative to OTs. Because of limitations in the data, we could not verify if patients were discharged with an outpatient therapy referral. Therefore, we combined therapists' recommendation of "home without therapy" and "home with outpatient therapy" as 1 category, "home (with or without outpatient therapy)."

Postacute care setting discordance occurred when (1) the therapist recommended home health and the patient went home with no home health or (2) the therapist recommended a postacute care facility and the patient went home with or without home health (Table 1).

Covariates included demographic (eg, sex, race, age, marital status, primary insurance type, income by ZIP code) and clinical variables (eg, length of stay, intensive care unit use, risk of mortality,[20] severity of illness,[20] comorbidities,[21] total number of therapist visits, and functional status).[18] The risk of mortality (minor, moderate, major, extreme) and severity of illness variables (minor, moderate, major, extreme) were created using All Patient Refined Diagnosis Related Group algorithms.[20] These variables have been used for cost adjustment within hospital systems as well as risk adjustment in claims data research.[22] Comorbidities were represented by total count as well as the presence of the following relevant comorbidities: peripheral vascular disease, chronic pulmonary disease, diabetes mellitus (complicated), renal failure, liver disease, coagulopathy, obesity, blood loss anemia, alcohol abuse, drug abuse, depression, neurological disorder, and cancer.

Functional status was measured with the Activity Measure for Post-Acute Care (AM-PAC) "6-clicks," a validated instrument that measures basic mobility and ADL.[18] The AM-PAC basic mobility scale and ADL scale range from 6 to 24, with lower scores indicating

Table 1. Therapist Recommended Postacute Setting Versus Actual Discharge Setting (n=25 500)

Therapist Recommended	Actual Discharge Setting		
	Home, n (%)	Home Health Care, n (%)	Postacute Care Facility, n (%)
Home	1139 (42.8)	1333 (50.1)	190 (7.1)
Home with home health	1914 (25.3)	5006 (66.2)	640 (8.5)
Postacute care facility	1142 (7.5)	2201 (14.4)	11 935 (78.1)

Grey shading: actual discharge setting is *discordant* when setting is less intensive than therapist recommendation.
No shading: actual discharge setting is *concordant* when setting is equal to or more intensive than therapist recommendation.

more difficulty performing the task. Nursing assessed patient mobility upon admission using the AM-PAC basic mobility scale (eg, bed mobility, sitting down/standing up from a chair, ambulation, stair negotiation) and the AM-PAC ADL scale (eg, bathing, dressing, toileting). Because of the skewed distribution of the AM-PAC data for both mobility and ADL scales, we categorized the measures as total assistance (AM-PAC=6), major limitations (7–13), moderate limitations (14–18), minor limitations (19–23), and total independence (AM-PAC=24). The minor, moderate, and major categories were created on the basis of the tertile distribution of the data. All variable definitions are provided in Table S2.

We imputed the following missing variables using the median or mode: for missing race (1.5%), we imputed White race; for missing marital status (3.0%), we imputed married; for missing risk of mortality (0.03%) and severity of illness (0.02%), we imputed major; and for missing median household income (0.3%), we imputed the median value.

Statistical Analysis

We first generated descriptive statistics to describe the degree of discordance between therapist-recommended versus actual postacute care discharge setting and then examined the demographic and clinical characteristics of the sample stratified by setting discordance/concordance.

To examine the association between setting discordance and 30-day hospital readmission, we used generalized linear mixed models with a random intercept for hospital, controlling for sociodemographic and clinical factors. Because AM-PAC ADL scores were highly correlated with the AM-PAC mobility scores (Spearman rho=0.86), we excluded this measure from our analysis. We assessed the association between setting discordance and readmission for the full sample and the subgroup of individuals with low mobility ($\leq$16) and high mobility (>16) scores based on the median split.

We conducted 4 sensitivity analyses. We first conducted our analysis including individuals who died within the first 30 days after discharge without a hospital readmission preceding the event (N=26 798). Our dependent variable for this analysis was death or readmission within 30 days. Our second sensitivity analysis excluded all records with missing data (ie, records with imputed values). Third, we examined setting discordance on the basis of a 4-level measure of discharge setting (ie, home, home with home health, IRF, SNF). Finally, we conducted our analysis on the subgroup of patients who had had a primary diagnosis of CHF (N=4480) (Table S1 and S3).

We also used a generalized linear mixed model to examine the sociodemographic and clinical predictors of setting discordance. To understand the predictive value of sociodemographic and clinical factors, versus controlling for these factors, we created a more parsimonious set of variables, eliminating those that were collinear with each other. Specifically, we eliminated the severity of illness and risk of mortality measures that were highly correlated with the comorbidity index, the AM-PAC ADL measure that was highly correlated with the AM-PAC mobility measure, and the individual comorbidities that were correlated with each other and the overall comorbidity index. We also created a dichotomous variable to indicate when PT and OT discharge setting recommendations were in agreement. This study was reviewed by the university's Institutional Review Board and was classified as exempt. All analyses were performed using STATA version 16.1 (StataCorp, College Station, TX).

RESULTS

The sample consisted of 25 500 (39.6%) adult patients (Figure S1). Of patients who had at least one PT or OT visit (n=39 220), 9906 (25.3%) were missing postacute rehabilitation recommendations, and 2516 (6.4%) had unclear postacute rehabilitation recommendations. Patients with missing recommendations were generally younger and had fewer comorbidities (Table S4). Patients with unclear recommendations were generally older, women, and less ill (Table S4).

Overall, the sample was 55% women and 89% White, and 80% were aged >65 years old (Table 2). The median hospital length of stay was 6.7 days and the median number of comorbidities was 7. Most patients had mobility (64%) and ADL (53%) limitations that were moderate or greater as measured by the AM-PAC. The setting discordance rate was 20.6%, and the 30-day readmission rate was 23.7%. There were differences between groups based on discordance (Table 2). For example, therapists' recommendations were more likely followed when patients were in the highest category for risk of mortality and severity of illness measurements, had longer intensive care unit stays, had severe limitations in AM-PAC mobility and ADL scores, and had more visits with therapists.

Of those recommended to go home with home health, 25.3% went home with no home health. Of those recommended to a postacute care facility, 7.5% went home without home health, and 14.4% went home with home health (Table 1).

Postacute Setting Discordance and 30-Day Readmission

Figure 1 illustrates the association between setting discordance and 30-day readmission for the full sample and the high and low mobility subgroups (AM-PAC

Table 2. Patient Demographic and Clinical Characteristics by Post-Acute Discharge Setting Concordance/Discordance (n=25 500)

	Setting Concordance, N (%) N=20 243 (79.4%)	Setting Discordance, N (%) N=5257 (20.6%)	Total n=25 500
Age, y (%)			
18–55	1177 (5.8)	315 (6.0)	1492 (5.9)
56–65	2870 (14.2)	861 (16.4)	3731 (14.6)
66–75	4875 (24.1)	1314 (25.0)	6189 (24.3)
76–85	6172 (30.5)	1556 (29.6)	7728 (30.3)
86+	5149 (25.4)	1211 (23.0)	6360 (24.9)
Sex, n (%)			
Male	9204 (45.5)	2374 (45.2)	11 578 (45.4)
Female	11 039 (54.5)	2883 (54.8)	13 922 (54.6)
Race, n (%)			
White	18 064 (89.2)	4620 (87.9)	22 684 (89.0)
Black	1990 (9.8)	586 (11.2)	2576 (10.1)
Other‡	189 (0.9)	51 (1.0)	240 (0.9)
Marital status, n (%)			
Married	9115 (45.0)	2343 (44.6)	11 458 (44.9)
Divorced/Widowed	7929 (39.2)	2066 (39.3)	9995 (39.2)
Single	3199 (15.8)	848 (16.1)	4047 (15.9)
Insurance, n (%)			
Commercial	4217 (20.8)	1016 (19.3)	5233 (20.5)
Medicare	14 705 (72.6)	3845 (73.1)	18 550 (72.8)
Medicaid	1061 (5.2)	313 (6.0)	1374 (5.4)
Self-pay	29 (0.1)	12 (0.2)	41 (0.2)
Other	231 (1.1)	71 (1.4)	302 (1.2)
Median income by ZIP code, mean (SD)	47 949.7 (15 738.0)	46 988.8 (15 838.9)	47 751.6 (15 763.3)
Hospital LOS, median (IQR)	6.9 (4.4–10.9)	5.7 (3.8–8.8)	6.7 (4.2–8.8)
% ICU use (%)	6210 (30.7)	1268 (24.1)	7478 (29.3)
Mean (SD) ICU days*	5.1 (7.1)	3.7 (4.0)	4.8 (6.7)
AM-PAC mobility, n (%)			
6 (total assistance)	1297 (6.4)	244 (4.6)	1541 (6.0)
7–15 (major limitations)	5812 (28.7)	1301 (24.8)	7113 (27.9)
16–19 (moderate limitations)	5996 (29.6)	1718 (32.7)	7714 (30.3)
20–23 (minor limitations)	3766 (18.6)	1193 (22.7)	4959 (19.5)
24 (total independence)	2274 (11.2)	576 (11.0)	2850 (11.2)
Missing, n (%)	1098 (5.4)	225 (4.3)	1323 (5.2)
AM-PAC ADLs, n (%)			
6 (total assistance)	1154 (5.7)	228 (4.3)	1382 (5.4)
7–15 (major limitations)	4876 (24.1)	1094 (20.8)	5970 (23.4)
16–19 (moderate limitations)	4775 (23.6)	1262 (24.0)	6037 (23.7)
20–23 (minor limitations)	4312 (21.3)	1353 (25.7)	5665 (22.2)
24 (total independence)	4028 (19.9)	1095 (20.8)	5123 (20.1)
Missing, n (%)	1098 (5.4)	225 (4.3)	1323 (5.2)
Diagnoses, n (%)			
Peripheral vascular disease	5401 (26.7)	1385 (26.4)	6786 (26.6)
Chronic pulmonary disease	9027 (44.6)	2541 (48.3)	11 568 (45.4)
Diabetes mellitus (complicated)	6751 (33.4)	1849 (35.2)	8600 (33.7)
Renal failure	8250 (40.8)	2249 (42.8)	10 499 (41.2)

(Continued)

Table 2.   (Continued)

	Setting Concordance, N (%) N=20 243 (79.4%)	Setting Discordance, N (%) N=5257 (20.6%)	Total n=25 500
Liver disease	1399 (6.9)	364 (6.9)	1763 (6.9)
Coagulopathy	2403 (11.9)	527 (10.0)	2930 (11.5)
Obesity	4907 (24.2)	1348 (25.6)	6255 (24.5)
Blood loss anemia	349 (1.7)	85 (1.6)	434 (1.7)
Alcohol abuse	661 (3.3)	192 (3.7)	853 (3.4)
Drug abuse	389 (1.9)	122 (2.3)	511 (2.0)
Depression	5008 (24.7)	1286 (24.5)	6294 (24.7)
Neurological	3529 (17.4)	802 (15.3)	4331 (17.0)
Cancer	1646 (8.1)	421 (8.0)	2067 (8.1)
Severity of illness, n (%)			
Minor	298 (1.5)	56 (1.1)	354 (1.4)
Moderate	4136 (20.4)	1133 (21.6)	5269 (20.7)
Major	11 068 (54.7)	3140 (59.7)	14 208 (55.7)
Extreme	4741 (23.4)	928 (17.7)	5669 (22.2)
Risk of mortality, n (%)			
Minor	75 (0.4)	32 (0.6)	107 (0.4)
Moderate	5946 (29.4)	1603 (30.5)	7549 (29.6)
Major	9804 (48.4)	2716 (51.7)	12 520 (49.1)
Extreme	4418 (21.8)	906 (17.2)	5324 (20.9)
Elixhauser comorbidity index, mean (SD)	6.8 (2.2)	6.8 (2.1)	6.8 (2.1)
Median (IQR)	7 (5–8)	7 (5–8)	7 (5–8)
Number of therapist visits, n (%)			
Low (1–3)	5085 (25.1)	1867 (35.5)	6952 (27.3)
Med (4–6)	7564 (37.4)	2122 (40.4)	9686 (38.0)
High (7+)	7594 (37.5)	1268 (24.1)	8862 (34.8)
Visits by therapists, mean (SD)			
PT total visits	4.3 (3.3)	3.6 (2.5)	4.2 (3.2)
OT total visits	2.6 (2.8)	1.9 (2.3)	2.5 (2.7)
30-day readmission, n (%)	4719 (23.1)	1322 (25.2)	6041 (23.7)
Days to readmission[†], mean (SD)	12.7 (8.6)	12.9 (8.8)	12.8 (8.7)

ADLs indicates activities of daily living; AM-PAC, Activity Measure for Post-Acute Care; ICU, intensive care unit; IQR, interquartile range; LOS, lemgth of stay; OT, occupational therapist; and PT, physical therapist.

*Conditional on ICU use.

†(n=6041).

‡Other indicates American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander; Unknown

mobility ≤16 or >16). Setting discordance was associated with greater odds of readmission (adjusted odds ratio, 1.12; 95% CI, 1.04–1.20; *P*=0.002). The point estimate for those classified in the lower mobility group (AM-PAC mobility ≤16) was greater (adjusted odds ratio, 1.20; 95% CI, 1.08–1.33; *P*=0.001) than that for the high mobility group (adjusted odds ratio, 1.10; 95% CI, 0.99–1.22; *P*=0.064), though the confidence intervals for these point estimates overlapped and the odds ratio for the high mobility group was nonsignificant. Our full model results are presented in Table S5.

Results of the sensitivity analyses are presented in Table S6. The results were generally similar, though some findings were nonsignificant because of smaller sample sizes when including individuals who died within 30 days (n=1298); when using a 4-level discharge categorization (ie, home, home health, SNF, IRF); when excluding records with missing data (n=992); and for those who had a primary CHF diagnosis (n=4480). Of the 6044 individuals who had a readmission within 30 days, ≈20% (N=1322) were discharged to a less intensive setting than recommended. Figure 2 presents data on the distribution of the readmissions with discordant discharges. Over 70% of the discordant discharges were instances when the patient was recommended for a postacute care facility but instead went home with or without home health (Figure 2).
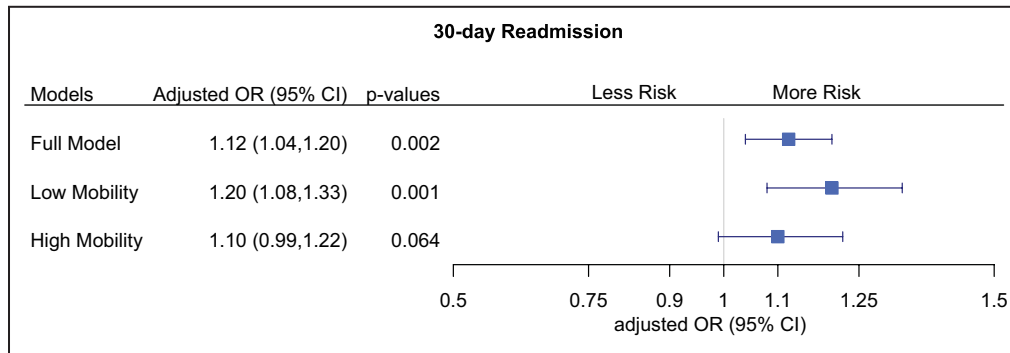
Figure 1. Multilevel analysis of the association between setting discordance and 30-day all-cause readmission.
Mixed-effects model with random intercept for hospital, controlling for demographics, insurance, median income, comorbidities, length of stay, intensive care use, mortality risk, illness severity, AM-PAC mobility score only, discharge destination, total visits from physical and occupational therapy. Full model: n=25 500. Low mobility (AM-PAC ≤16): n=11 972. High mobility (AM-PAC >16): n=12 205. OR, odds ratio.

Predictors of Postacute Setting Discordance

Figure 3 presents the analysis examining sociodemographic and clinical factors associated with setting discordance. Relative to patients with total assist and major mobility limitations, patients with moderate to minor limitations were more likely to discharge to

Figure 2. Discordant recommendations and discharge settings (n=1322).
Percentage of discordant discharges with readmission within 30 days. Description: Majority of readmissions across 30 days were recommended for a postacute care facility but went home with or without home health services (mean: 69.2%) vs recommendations for home with home health and went home without services (mean, 30.8%). DC indicates discharge; HH, home health; PAC, postacute care facility; and Rec, therapist recommendation.

discordant settings. Patients with ≥8 comorbidities were also more likely to be in discordant settings. Based on the point estimate, there was some suggestion that patients on Medicaid, self-pay, or other insurance (relative to commercial insurance) were more likely to have discordant discharges, though the findings were nonsignificant. Patients aged ≥76 years (relative to those aged 18–55 years), those with a higher median household income, longer hospital stays, more therapist visits, and the same setting recommendations from both therapists were more likely to discharge to the therapists' recommended postacute setting with the same or higher rehabilitation intensity.
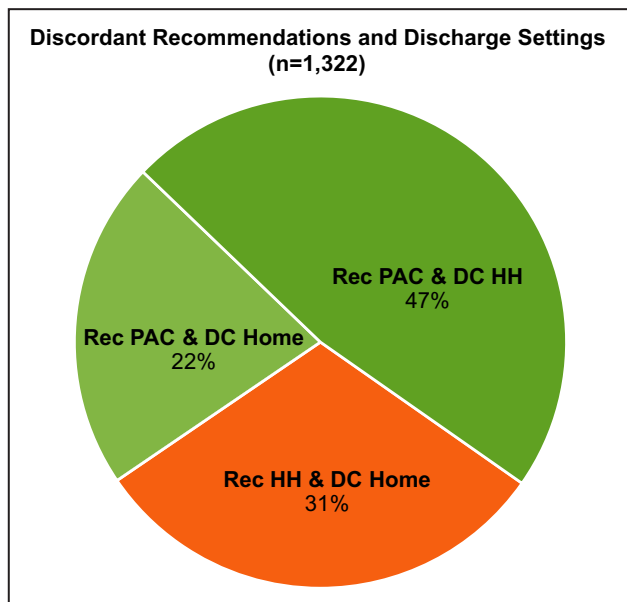
DISCUSSION

This study is the first large-scale analysis examining whether discordance between recommended and actual postacute care setting was associated with hospital readmission in patients with CHF. We found that setting discordance was associated with greater odds of 30-day hospital readmission. We also found this effect was slightly larger in the subgroup of individuals with low mobility scores. Patients discharged to a less intensive setting than recommended are likely at greater risk of complications or events (eg, falls) that may lead to a rehospitalization. Those with greater mobility limitations may be particularly vulnerable. Several studies have identified a direct relationship between mobility limitations and risk of readmission.[23,24]

Our work supports and extends prior literature.[12,13] In a retrospective cohort study involving 762 patients admitted to the medical/surgical unit of an academic hospital, Smith et al[13] found that patients were 2.9 times more likely to be readmitted within 30 days when the physical therapists' recommendations were
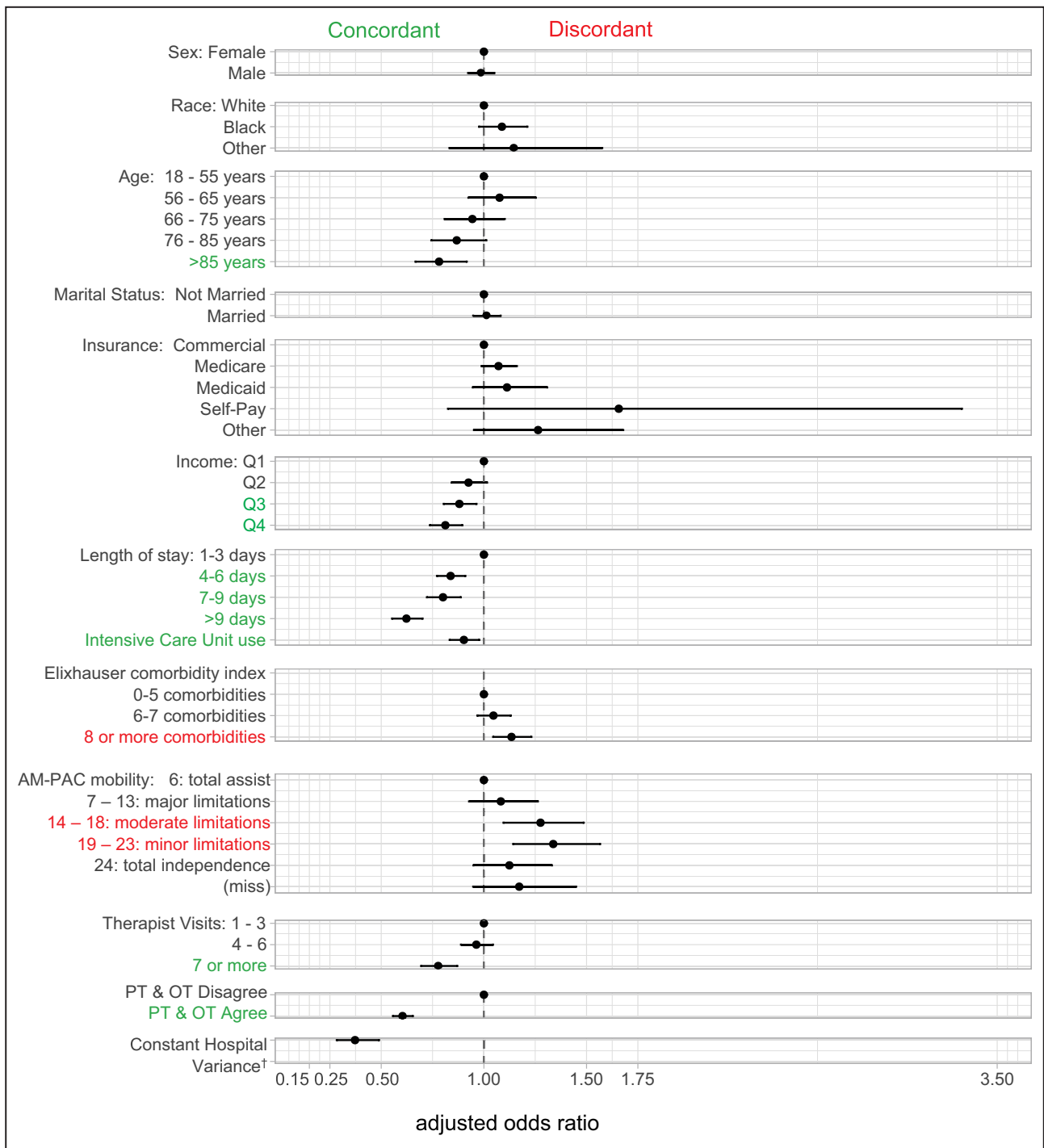
Figure 3.　Sociodemographic and clinical factors associated with setting discordance (n=25 500).
Controlling for demographics, insurance, median income, comorbidities, length of stay, ICU use, AM-PAC mobility scores only, total visits from physical and occupational therapy; recommendation agreement between therapists.
†Hospital variance adjusted odds ratio, 0.06; 95% CI, 0.03–0.14). AM-PAC, Activity Measure for Post-Acute Care; OT, occupational therapist; PT, physical therapist; Q1, first quartile; Q2, second quartile; Q3, third quartile; and Q4, fourth quartile.

not followed. Another study examined 322 patients discharged after an acute care hospitalization and reported an increased readmission risk when PT recommendations for postacute PT services were not met (adjusted odds ratio, 1.18; 95% CI, 1.08–3.03).[12]

Limitations of both studies include: small heterogeneous samples from a single hospital, lack of control for confounders such as illness severity, comorbidities, and mobility status of the patient, and exclusion of OT recommendations.

The majority of patients who had a readmission and a discordant discharge were recommended for a postacute facility (ie, IRF or SNF) but were discharged home with or without home health. Therapists typically recommend a post-acute care facility if there are significant rehabilitation needs or if the patients' safety and needs cannot be met at home. Insufficient social support at home can likely trigger adverse events requiring rehospitalization.[12,25,26] Our results suggest this may have been the case for our sample.

We identified several predictors of discordant care. People in the midrange of mobility problems were more likely to be in discordant postacute settings relative to those with extreme mobility limitations (total assistance: AM-PAC score of 6, chi-square P=0.002) and those with no mobility limitations (total independence: AM-PAC score of 24, chi-square P=0.002). These findings may be related to a "disconnect" between the therapist's evaluation and how the patient appears to other team members (eg, family, discharge planners, physicians). For example, despite the chronic nature of CHF, the therapist may recognize rehabilitation potential even in those patients who have multiple comorbidities in addition to CHF. Likewise, the therapist may uncover subtle impairments and environmental barriers in those with minor to moderate mobility limitations that would benefit from a more intensive postacute care setting.[27]

Older patients and those with higher household incomes were more likely to receive the recommended level of care or higher. The reasons behind these findings are less clear but possibly related to insurance and patient resources, which may facilitate discharge to the appropriate postacute care setting.[28] While insurance was not a significant predictor of discordant care, the point estimates of insurance coverage (ie, Medicaid, self-pay, other) was associated with discordant care. As might be expected, patients with more therapist visits and longer lengths of stay were more likely to be in concordant postacute settings. This is likely attributable to the additional time the therapist had with the patient,[29–31] the patient's family, and the care team at the hospital, leading to a more informed postacute rehabilitation recommendation by the therapist. Having the same recommendation between both therapists was one of the strongest significant predictors of concordant discharges. This is likely attributable, in part, to a clear and consistent message across disciplines. Consistent messages about discharge recommendations from PTs and OTs to patients and the care team may carry more weight with decision making.

Readmission rates for CHF are common, expensive, and often considered preventable.[4,32] Frailty and severe impairments across multiple domains of function, including strength, balance, mobility, and endurance, have been documented in the CHF population and are thought to contribute to readmissions.[33] Data also suggest that improving physical function in this population may reduce readmission risk.[34] Identification of social and physical function barriers at the point of care may lead to the timely targeting of appropriate resources, especially physical therapy–directed rehabilitative services, for at-risk patients.

Discharge planning is a complex process that involves several key players including the patient, the patient's family, PT and OT, nursing, the attending physician, social work, and the discharge coordinator. Successful discharge planning requires a coordinated effort from all acute team members to provide clear and consistent communication to the patient and decision makers. Discharge coordinators should also facilitate follow-up with outpatient CHF care providers to improve continuity of care.[35,36] Potential reasons behind setting discordance are varied and may be attributable to patient preference, patient resources, insurance restrictions, or postacute care availability. The influence of the health care team members may also impact the patient's postacute care choice.

The Institute of Medicine and Centers for Medicare and Medicaid Services recommends that hospitalization determinants (eg, health literacy, social support, and physical and cognitive function)[37] be captured in electronic health records for value-based care and population health management.[38–40] Such information has rarely been captured and, if it is, has been used inconsistently to inform clinical decisions or care plans.[40] Identifying appropriate social support is often a challenge for the care team during an acute hospitalization. Of the 2516 unclear therapist postacute setting recommendations in our study, 21.4% recommended a discharge to home contingent on the availability of social support; otherwise, a postacute facility would be the alternative recommendation. Future studies should acquire information on the availability of household support and verify the caregiver's capability, as it is an important factor when providing adequate physical assistance and helping the patients' medical and dietary compliance.[41]

Limitations

Our study is not without limitations. We used an observational design and cannot conclude a causal relationship between discordant recommendations and hospital readmission. There is also the potential for unmeasured confounding not captured by the variables in our model. Our analysis was also limited to a single health system, and we excluded patients without therapist visits reducing the external validity of our findings. In addition, >80% of our sample had a secondary rather than a primary diagnosis of CHF. Previous studies have recommended identifying CHF via secondary diagnoses attributable to readmission penalties, incentivizing hospitals to avoid putting CHF in the primary

diagnosis position.[42] We analyzed individuals who were hospitalized for surgical (30.8% of the sample) versus medical reasons based on Diagnosis Related Group codes, and our results were similar. Finally, we had incomplete information on some important variables including readmission outside the health system, reason for readmission, and secondary insurance.

CONCLUSIONS

Patients with CHF who were discharged to less intensive postacute settings than recommended were more likely to be readmitted to the hospital in 30 days. When stratifying by high and low mobility scores, the effect was slightly larger in the subgroup with low mobility scores. We also found that the majority of individuals who were readmitted and had discordant discharges were recommended for a postacute care facility but went home. Both clinical and sociodemographic factors such as high comorbidity burden, therapist disagreement on postacute discharge setting, and midrange physical functional limitations were associated with postacute setting discordance. Systematic assessments of social and functional health determinants at the point of clinical care may improve CHF management and readmission risk by timely identification of rehabilitation needs and community resources available to optimize patient self-management for improved health, especially upon discharge.[43,44]

Affiliations

Department of Physical Therapy, University of Pittsburgh, PA (A.C., J.K.F.); UPMC Rehabilitation Services, Pittsburgh, PA (T.E., B.M.); Department of Orthopaedic Surgery, Division of Physical Therapy, and Duke Claude D. Pepper Older Americans Independence Center, Duke University School of Medicine, Durham, NC (A.M.P.); and Wolff Center, UPMC, Pittsburgh, PA (A.B.).

Supplementary Material

Table S1–S6
Figure S1

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SUPPLEMENTAL MATERIAL

Table S1. ICD -10 Codes for CHF.

DIAGNOSIS CODE	DIAGNOSIS DESCRIPTION
I43	Cardiomyopathy in diseases classified elsewhere
I50	Heart failure
I099	Hypertensive heart disease with heart failure
I110	Hypertensive heart disease with heart failure
I130	Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease
I132	Hypertensive heart and chronic kidney disease with heart failure and with stage 5 chronic kidney disease, or end stage renal disease
I255	Ischemic cardiomyopathy
I420	Dilated cardiomyopathy
I425	Other restrictive cardiomyopathy
I426	Alcoholic cardiomyopathy
I427	Cardiomyopathy due to drug and external agent
I428	Other cardiomyopathies
I429	Cardiomyopathy, unspecified
P290	Neonatal cardiac failure

Table S2. Variable Definitions and Specifications for Modelling.

Variable	Definition	Source
Demographics		
Sex	Categorized as: Male, Female	UPMC Discharge and Inpatient Billing Data
Race	Categorized as: White, Black, Other Missing data replaced with "white"	UPMC Discharge and Inpatient Billing Data
Age	Categorized as: 18 – 55 years, 56 – 65 years, 66 – 75 years, 76 – 85 years, 86 years and older	UPMC Discharge and Inpatient Billing Data
Marital Status	Categorized as: Married, Not Married; missing data replaced with "married"	
Insurance	Categorized as: Commercial, Medicare, Medicaid, Self-Pay, Other (e.g., veterans administration, auto insurance payers and homeowners liability claims)	UPMC Discharge and Inpatient Billing Data
Median Household Income	Based on patient ZIP code and categorized based on the quartile distribution; median value imputed for missing data	Census Data
Clinical		
Length of stay	Categorized as: 0 – 3 days, >3 – 6 days, >7 – 9 days, >9 days based on quartile distribution	UPMC Discharge and Inpatient Billing Data
ICU use	Yes/no: Intensive care unit use during inpatient stay	UPMC Discharge and Inpatient Billing Data
Severity of Illness	APR-DRG classification: categorized as minor, moderate, major, extreme	UPMC Discharge and Inpatient Billing Data
Risk of Mortality	APR-DRG classification: categorized as minor, moderate, major, extreme; mean value imputed for missing data	UPMC Discharge and Inpatient Billing Data
Indicators for comorbidities	Yes/no: peripheral vascular disease, chronic pulmonary disease, diabetes (complicated), renal failure, liver disease, coagulopathy, obesity, blood loss anemia, alcohol abuse, drug abuse, depression, neurological disorder, and cancer	UPMC Discharge and Inpatient Billing Data
Elixhauser comorbidity count	Ranges from 0 – 31; categorized as: 3 or less, 4 – 5, 6 – 7, 8 or more	UPMC Discharge and Inpatient Billing Data
AM-PAC Mobility Score	Categorized by functional mobility limitations: 6 –unable to perform any tasks, 7-13 – major mobility limitations, 14-18 - moderate mobility limitations, 19-23 – minor mobility limitations, 24 – no mobility limitations Moderate mobility limitations imputed for missing data	UPMC Electronic Health Record
Discharge Destination	Categorized as: Home: home with outpatient services or without home health services, Home Health: Home with home health services, Post-Acute Care facility: Skilled nursing facility or Inpatient rehabilitation facility	UPMC Electronic Health Record
Therapy Visits (amount)	Categorized as: total number of visits from PT or OT: 1-3 visits, 4-6 visits, 7 or more visits	UPMC Discharge and Inpatient Billing Data
Therapist Recommendation Agreement	Categorized as: agreed (PT and OT recommendation exactly the same), disagree (PT and OT recommendation not the same)	UPMC Electronic Health Record
Outcomes		
Died within 30 days	Yes/no: Died within 30 days with or without an in-system readmission	Social Security Death Index (SSDI)
Within system 30-day Readmission	Yes/no: Readmitted to a UPMC hospital within 30 days	UPMC Discharge and Inpatient Billing Data
Readmitted or died within 30 days	Yes/no: Readmitted within system or died within 30 days	UPMC Discharge and Inpatient Billing Data & SSDI

Table S3. Therapist Recommended Post-acute Setting versus Actual Discharge Setting, 4-level definition

Therapist-Recommendations		Actual Discharge Setting			
		Community (Comm)		Post-Acute Care Facility (PAC)	
Comm	Home	Home	HH	SNF	IRF
	HH	Home	HH	SNF	IRF
PAC	SNF	Home	HH	SNF	IRF
	IRF	Home	HH	SNF	IRF

: Home: Home without home services, HH: Home with home health services, PAC: Post-acute care facilities, Comm: Community setting
Red shading: actual discharge setting is <u>discordant</u> when setting is less intensive than therapist recommendation
Green shading: actual discharge setting is <u>concordant</u> when setting is equal to or more intensive than therapist recommendation

Table S4. CHF: Patient Demographic & Clinical Characteristics between Definitive vs. Unclear vs. Missing Discharge recommendations (N=39 220).

	Definite DC Rec (N= 26 798[a])	Unclear (N=2 516)	Missing (N=9 906)	Total (N=39 220)
Age, n (%)				
18-55	1 518 (5.7)	120 (4.8)	763 (7.7)	2 401 (6.1)
56-65	3 828 (14.3)	304 (12.1)	1 656 (16.7)	5 788 (14.8)
66-75	6 422 (24.0)	471 (18.7)	2 512 (25.4)	9 405 (24.0)
76-85	8 162 (30.5)	704 (28.0)	2 760 (27.9)	11 626 (29.6)
86+	6 868 (25.6)	917 (36.5)	2 215 (22.4)	10 000 (25.5)
Sex, n (%)				
Male	12 242 (45.7)	1027 (40.8)	4 784 (48.3)	18 053 (46.0)
Female	14 556 (54.3)	1 489 (59.2)	5 122 (51.7)	21 167 (54.0)
Race, n (%)				
White	23 913 (89.2)	2 229 (88.6)	8 658 (87.4)	34 800 (88.7)
Black	2 639 (9.9)	263 (10.5)	1 148 (11.6)	4 050 (10.3)
Other	246 (0.9)	24 (1.0)	100 (1.0)	370 (0.9)
Hospital LOS, Mean (SD)	8.7 (7.9)	7.1 (6.4)	5.4 (7.3)	7.8 (7.8)
Median (IQR)	6.8 (4.2-10.4)	5.7 (3.8-8.5)	3.7 (2.3-6.1)	5.8 (3.7-9.5)
% ICU Use, n (%)	7 867 (29.4)	572 (22.7)	1 424 (14.4)	9 863 (25.2)
Mean (SD) ICU days[b]	4.9 (6.8)	4.5 (5.2)	3.1 (13.5)	4.6 (8.0)
Median Income by ZIP code, Mean (SD)	47 816.5 (15 789.2)	47 198.1 (15 229.3)	47 229.6 (1 5267.4)	47 628.6 (15 625.5)
AM-PAC mobility, n (%)				
6 (Total Assistance)	1 659 (6.2)	144 (5.7)	400 (4.0)	2 203 (5.6)
7-13 (Major Limitations)	7 574 (28.3)	688 (27.3)	1 469 (14.8)	9 731 (24.8)
14-18 (Moderate limitations)	8 126 (30.3)	896 (35.6)	2 510 (25.3)	11 532 (29.4)
19-23 (Minor limitations)	5 112 (19.1)	468 (18.6)	2 451 (24.7)	8 031 (20.5)
24 (Total independence)	2 928 (10.9)	205 (8.2)	1 841 (18.6)	4 974 (12.7)
Missing, n (%)	1 479 (5.5)	138 (5.5)	344 (3.5)	1 961 (5.0)
Elixhauser Comorbidity Index, Mean (SD)	6.9 (2.1)	6.8 (2.1)	6.3 (2.0)	6.7 (2.1)
Median (IQR)	7 (5-8)	7 (5-8)	6 (5-8)	7 (5-8)

HH: Home health; PAC: Post-acute care facility; AM-PAC: activity measure for post-acute care; DC: Discharge; LOS: length of stay; ICU: intensive care unit
[a]including patients who died within 30 days without a readmission preceding the event (n=1 298)
[b]conditional on ICU use

Table S5. Full model[*]: Outcome readmission at 30 days (N=25 500).

Variable	Odds Ratio	2.50%	97.50%	P-value
Concordant	1.00	---	---	---
Discordant	1.12	1.04	1.20	0.002
Male	0.99	0.93	1.05	0.702
Race: White	1.00	---	---	---
Black	1.16	1.05	1.29	0.003
Other	0.75	0.54	1.04	0.086
Age: 18 - 55 years	1.00	---	---	---
56 - 65 years	1.02	0.88	1.17	0.815
66 - 75 years	0.98	0.84	1.14	0.788
76 - 85 years	1.02	0.88	1.18	0.833
>85 years	0.93	0.79	1.09	0.351
Marital Status: Not Married	1.00	---	---	---
Married	0.91	0.86	0.97	0.005
Insurance: Commercial	1.00	---	---	---
Medicare	1.07	0.99	1.16	0.068
Medicaid	1.14	0.98	1.33	0.088
Self-Pay	1.11	0.54	2.31	0.770
Other	0.82	0.61	1.11	0.193
Median Household Income Q1	1.00	---	---	---
Median Household Income Q2	1.00	0.91	1.09	0.999
Median Household Income Q3	1.09	1.00	1.19	0.042
Median Household Income Q4	1.14	1.05	1.25	0.003
Length of stay: 0-3 days	1.00	---	---	---
4-6 days	1.07	0.98	1.17	0.138
7-9 days	1.24	1.12	1.38	< 0.001
>9 days	1.34	1.19	1.50	< 0.001
Intensive Care Unit use	1.00	0.93	1.08	0.968
Severity of Illness: minor	1.00	---	---	---
moderate	1.01	0.76	1.35	0.952
major	1.16	0.86	1.55	0.328
extreme	1.23	0.90	1.67	0.189
Risk of Mortality: minor	1.00	---	---	---
moderate	0.87	0.55	1.40	0.575
major	0.94	0.59	1.51	0.807
extreme	0.96	0.59	1.55	0.864

[*]controlling for demographics, insurance, median income, comorbidities, length of stay, ICU use, mortality risk, illness severity, AM-PAC mobility scores only, total visits from physical and occupational therapy

Table S5. Full model[*]: Outcome readmission at 30 days (N=25 500) (continued)

Variable	Odds Ratio	2.50%	97.50%	P-value
Comorbidities				
Peripheral Vascular Disease	1.09	1.02	1.17	0.013
Chronic Pulmonary Disease	1.10	1.04	1.18	0.002
Diabetes (complicated)	1.10	1.02	1.17	0.009
Renal Failure	1.19	1.11	1.27	< 0.001
Liver Disease	1.10	0.98	1.24	0.105
Coagulopathy	1.07	0.97	1.17	0.161
Obesity	0.96	0.89	1.04	0.331
Blood loss anemia	1.02	0.82	1.26	0.875
Alcohol Abuse	0.82	0.69	0.98	0.030
Drug Abuse	1.04	0.85	1.28	0.695
Depression	1.06	0.99	1.14	0.094
Neurological Disorder	0.89	0.82	0.97	0.007
Cancer	1.25	1.12	1.39	< 0.001
Elixhauser comorbidity index:				
0-3 comorbidities	1.00	---	---	---
4-5 comorbidities	1.21	1.02	1.45	0.034
6-7 comorbidities	1.20	1.00	1.43	0.051
8+ comorbidities	1.44	1.18	1.75	< 0.001
AM-PAC mobility: 6: total assist	1.00	---	---	---
7-13: major limitations	1.07	0.94	1.22	0.310
14-18: moderate limitations	1.11	0.97	1.27	0.127
19-23: minor limitations	1.00	0.87	1.15	0.959
24: total independence	0.90	0.77	1.04	0.153
missing	0.30	0.23	0.38	< 0.001
1-3 therapist visits	1.00	---	---	---
4-6 therapist visits	0.93	0.86	1.00	0.055
7 or more therapist visits	0.92	0.84	1.02	0.100
Constant	0.16	0.09	0.28	< 0.001
Hospital Variance	0.0027	0.0004	0.02	---

controlling for demographics, insurance, median income, comorbidities, length of stay, ICU use, mortality risk, illness severity, AM-PAC mobility scores only, total visits from physical and occupational therapy

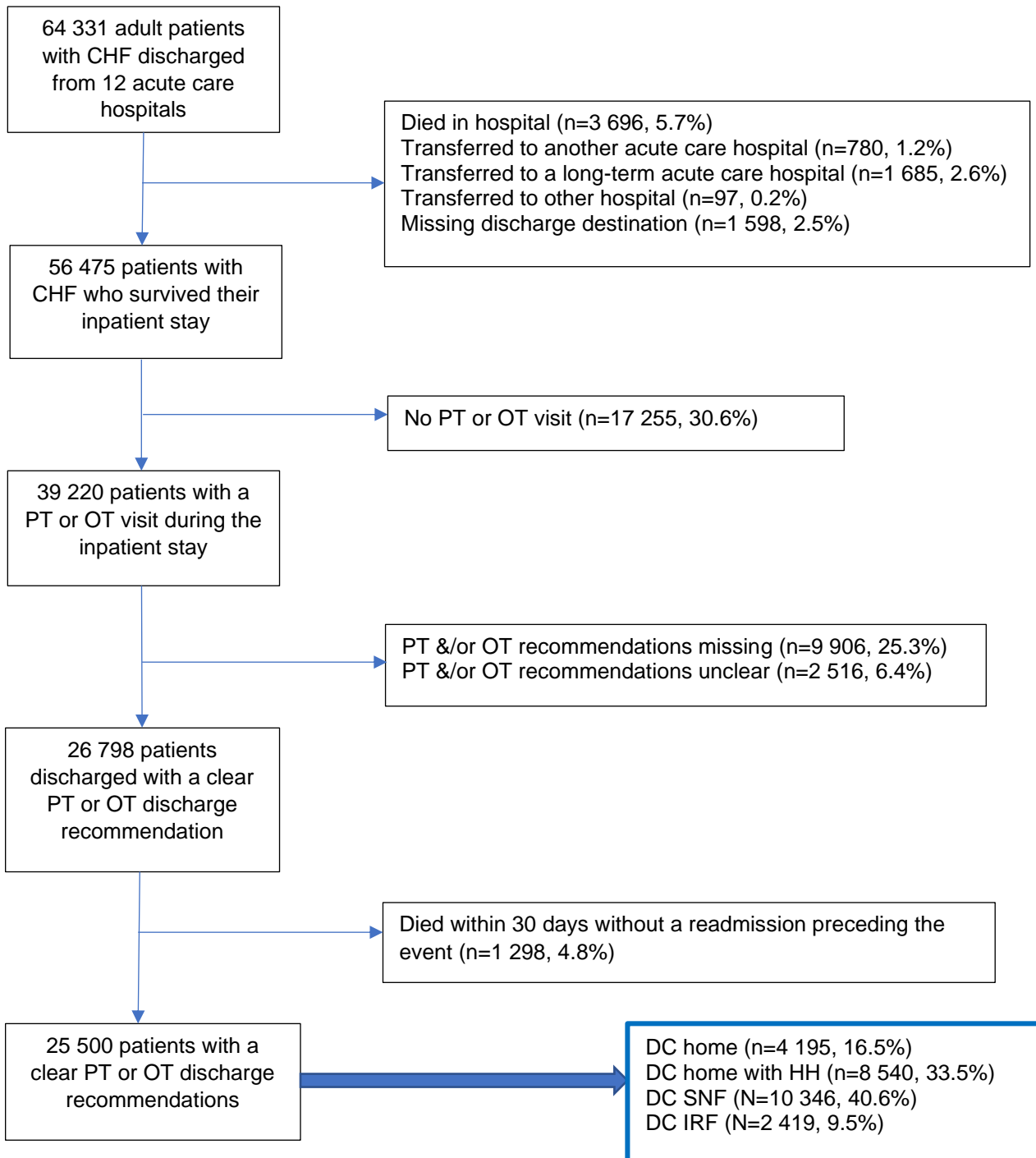**Table S6. Sensitivity Analyses: Comparing discordance classifications on 30-day readmission outcome[*]**

		30-Day readmission										
		Full Model			**Mobility - Low**			**Mobility - High**				
		ODDS RATIO	**95% CI**		**P-value**	**ODDS RATIO**	**95% CI**		**P-value**	**ODDS RATIO**	**95% CI**		**P-value**
	Concordant	1.00	-	-	-	1.00	-	-	-	1.00	-	-	-
Discordance models	**3-level, less[#] (Final model) n=25 500**	1.12	1.04	1.20	0.002	1.20	1.08	1.33	0.001	1.10	0.99	1.22	0.064
	3-level, less[#] (with post-discharge deaths)[@], n= 26 798	1.07	1.00	1.15	0.058	1.11	1.01	1.23	0.036	1.08	0.98	1.19	0.125
	3-level, less[#] (excluding all imputed missing variables), n= 24 508	1.13	1.05	1.22	0.001	1.16	1.04	1.29	0.006	1.07	0.97	1.19	0.162
	4-level, less[#], n=25 500	1.06	0.99	1.13	0.089	1.13	1.03	1.24	0.011	1.01	0.92	1.11	0.820
	3-level, less[#] (primary diagnosis CHF only), n=4 480	1.18	1.01	1.039	0.038	1.12	0.87	1.45	0.370	1.27	1.03	1.57	0.026

[*]*controlling for demographics, insurance, median income, comorbidities, length of stay, ICU use, mortality risk, illness severity, AM-PAC mobility scores only, total visits from physical and occupational therapy*

[#]*Less= actual discharge setting is <u>discordant</u> when setting is less intensive than therapist recommendation*

[@]*outcome: readmission or death*

Figure S1. Cohort Diagram.

64 331 adult patients with CHF discharged from 12 acute care hospitals

→ Died in hospital (n=3 696, 5.7%)
Transferred to another acute care hospital (n=780, 1.2%)
Transferred to a long-term acute care hospital (n=1 685, 2.6%)
Transferred to other hospital (n=97, 0.2%)
Missing discharge destination (n=1 598, 2.5%)

56 475 patients with CHF who survived their inpatient stay

→ No PT or OT visit (n=17 255, 30.6%)

39 220 patients with a PT or OT visit during the inpatient stay

→ PT &/or OT recommendations missing (n=9 906, 25.3%)
PT &/or OT recommendations unclear (n=2 516, 6.4%)

26 798 patients discharged with a clear PT or OT discharge recommendation

→ Died within 30 days without a readmission preceding the event (n=1 298, 4.8%)

25 500 patients with a clear PT or OT discharge recommendations

→ DC home (n=4 195, 16.5%)
DC home with HH (n=8 540, 33.5%)
DC SNF (N=10 346, 40.6%)
DC IRF (N=2 419, 9.5%)

CHF, Congestive Heart Failure; PT, physical therapist; OT, occupational therapist; DC, discharge; HH, home health;
SNF, skilled nursing facility; IRF, inpatient rehabilitation facility